

SOME FEATURES OF IMPORTANT TAXA OF SOIL
MESOFAUNA IN AN AFRO-MEDITERRANEAN
COASTAL DESERT.

V.- SOIL FAUNA ASSOCIATED WITH
THYMELAEA HIRSUTA.

BY

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SUMMARY

An experiment of protection from grazing was carried out since 1974 with 4 plots of 0%, 25% and 50% of the grazing pressure prevailing in the surrounding area. The grazing animals are sheep and goats and the vegetation consists mainly of *Thymelaea hirsuta* and *Anabasis articulata*. Samples of soil fauna were taken within the protected plots as well as from outside the fenced area. Data were treated by correspondence analysis and ascending hierarchical classification. Applying different rates of grazing pressure showed that herbivorous soil animals (potential plant pests), increased with protection from grazing, while the highest values of detritivores (responsible for soil fertility) belonged to the free open area. The other-two treatments were intermediate in both physical and chemical characteristics, between the free grazing and the completely protected plots.

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INTRODUCTION

This paper adds to the previous ones in the series and is concerned with changes in soil fauna populations as a result of applying various degrees of grazing pressure to a free grazing area in the Omayed Biosphere Reserve, the Mariut region, west of Alexandria, on the Mediterranean coast of Egypt (Ghabbour *et al.* 1991). The present paper deals with, changes in soil fauna populations under the shrub *Thymelaea hirsuta* Endl.

MATERIAL AND METHODS

The study area comprises about 48 ha fenced at different stages in 1974 and 1977 and declared by UNESCO/MAB as Omayed Biosphere Reserve in 1981, The area, the grazing: experiment, collections of samples, and treatment of data, are described by Ghabbour *et al.* (1991).

RESULTS

Table (1) shows results of range and means of water content % at surface, -20 and -50 cm depths, organic matter % and litter weight. For W and L sides of *Thymelaea* shrub under different treatments of grazing pressure. Fig.(1) shows graphic representation of the application of CA and AHC methods after disjunctive coding of the above mentioned factors into lower and higher categories. Sixty-five percent of total variance is associated with the first (horizontal) axis and 26% with the second (vertical) one. The first axis shows the effect of such treatment upon litter weight and water content % at surface. It appears that these two factors are- inversely related. The vertical axis shows the effect of the same treatments upon water content % at -20 and -50 cm depth and organic matter %. Organic matter is inversely related to the other two factors. The completely protected area (T2) is characterized by lower values of water content at surface and higher values of litter weight. The free grazing treatment (To) has medium values of litter weight and water content % at surface, lower values of water content % at -20 cm depth and organic matter % and higher val-

Table (1) Range and mean values of water content% at surface (WCS), water content% at -20 cm depth (WC2), water content% at -50 cm depth (WC5), organic matter% at surface (OMA) and litter weight (LWE) in gms, under different treatments of grazing pressure, for windward (W) and leeward (L) sides of *Thymelaea hirsuta* (n=5)

		WCS	WC2	WC5	OMA	LWE
T0,W	range	0.60-2.61	0.49-5.20	1.61-6.80	0.24-0.49	183-369
	mean	1.85	3.33	3.53	0.38	269
L	range	0.67-2.98	1.96-4.30	1.95-6.82	0.17-0.28	222-393
	mean	1.51	2.73	4.48	0.23	302
T1,W	range	2.15-3.64	0.16-5.15	0.27-3.28	0.11-0.33	143-275
	mean	2.93	3.68	2.37	0.25	2.15
L	range	1.55-3.72	2.06-5.06	1.22-2.97	0.19-0.39	1 go-264
	mean	2.43	2.71	2.06	0.32	244
T2,W	range	0.22-2.39	1.35-5.71	1.22-3.07	0.23-0.37	236-532
	mean	1.24	3.39	2.29	0.32	337
L	range	1.05-2.75	2.06-4.37	1.03-6.95	0.19-0.46	303-728
	mean	1.67	3.11	3.25	0.29	466
T3,W	range	2.52-3.59	1.57-4.17	2.38-9.89	0.30-1.31	126-316
	mean	3.06	2.83	5.03	0.55	228
L	range	0.22-5.18	1.48-5.36	1.95-4.23	0.18-0.31	208-419
		2.35	3.00	3.30	0.23	317

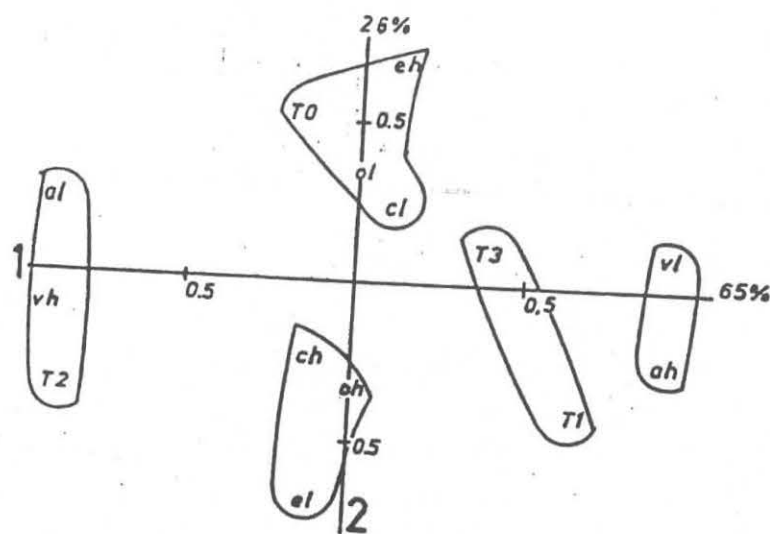


Fig. (1) Graphic representation of applying ordination techniques after dis-junctives coding of environmental data. Symbols: T0= free grazing area, T1= three-years of complete protection followed by 50 G.P., T2= complete protection since 1974, T3= 100% G.P. followed by 50% G.P., a= water content % at surface, c= water content% at -20 cm depth, e= water content% at -50 cm depth, o= organic matter, v= litter weight, l= lower and h=higher levels.

ues of water content % at -50 cm depth. The other two treatments, T1 (three-years of complete protection followed by 50% grazing pressure, G.P.) and T3 (100% G.P. followed by 50% G.P.) seem to be intermediate between the other two treatments. But T3 treatment has characteristics similar to those of T0 while characteristics of T1 treatment are nearer to those of T2.

The soil fauna of both windward (W) and leeward (L) sides of *Thymelaea* shrubs under the four treatments of grazing pressure during a period of one year (5 seasons) could be grouped into 35 taxa. Tables (2 and 3) shows the population density of these taxa under windward and leeward sides for all treatments of grazing pressure, for the entire period of sampling. Fig. (2) shows graphic representation of applying ordination techniques of the 35 taxa in the four treatments. Eighty-Four percent of the total variance is associated with the first axis and 11% with the second one. The first axis separates between T2 at the left and T0 and T1 at the right hand side of the figure. T3 is at the middle of the figure. T2 (the completely protected area) is characterized by higher densities of 8 taxa, of which : three taxa are herbivores; *Monomorium* sp., *Messor* sp., and *Pentatomidae*; three detritivores; *Pharoanus fasclulatus*, *Dendarus piceus* and *Pimelia* sp., and two carnivores; spiders and ticks. T10 and T1 treatments are similar to each other and have 14 taxa associated with them. These are: two herbivores; Hemiptera and *Capsodes* sp., 7 detritivores, Isopoda *Heterogamia syriaca*, *Scarsbaeidae* pupae, *Erodus quadrileneata*, *E. gibbus*, *Camponotus* sp., *Psammoica lucida* and 5 Caran'vores; *Graphopterus serrator*, *Saprinus* sp., *Scarites buparius*, *Geophilomorpha* and *Scorpions*. T3 seems to be intermediate, characterized by 10 taxa : two herbivores; *Brachycerus spinicollis* and *Apion* sp., 5 detritivores; *Scarabaeidae* larvae, *Psammobius porcicollis*, *Tenebrionidae* larvae, *Diptera* larvae and *Macchlopsis Crenatocostate* and 3 carnivores; *Cyminis suturalis*, *Pseudoscorpion* and *Mantidae*. *Thysanura* (detritivore) and antlions (carnivores) are common to T2 and T3 treatments. *Thysanura* seem to be associatid with T2 and antlions with T3. *Coc-*

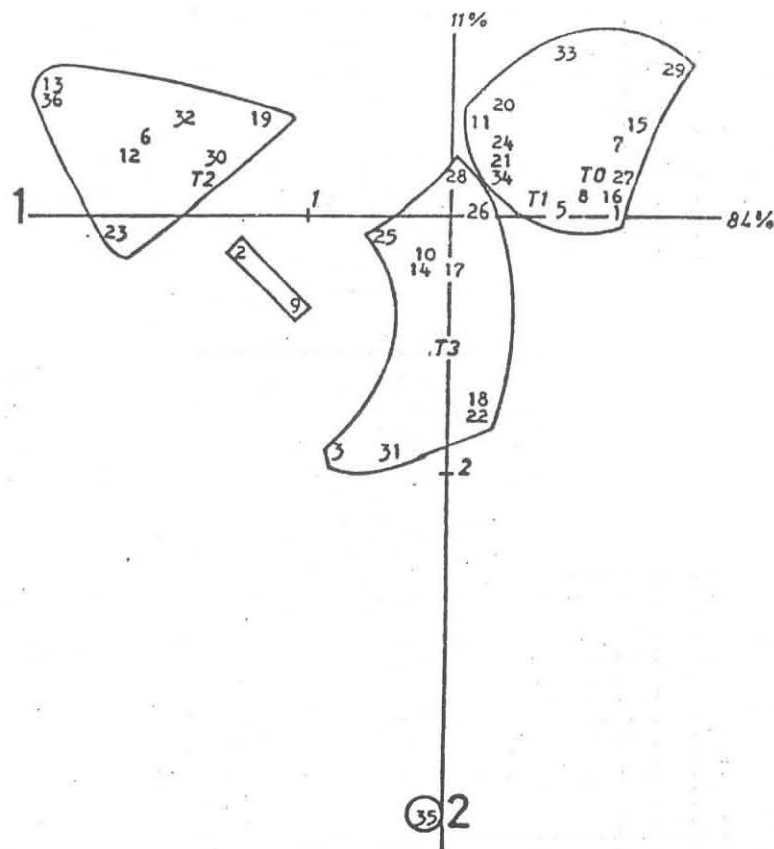


Fig. (2) Graphic representation of applying ordination techniques for data of population density of soil fauna after applying disjunctive coding. Symbols: number of species (1-35) as in Appendix Table, treatments as in Fig.(1).

cinella 11-p₂₂ is not affected by such treatment and is separated away along the second axis.

Data of population density of soil fauna in different sides of shrubs were treated again by ordination methods, in order to study to what extent is the difference between the two sides of sampled shrubs (Fig.3). Data were grouped by disjunctive coding. 67% of the total variance is associated with the first axis and 11% with the second one. The first axis separates between T2 treatment at one side of the figure and other treatments on the other side. Windward and leeward sides of T2 treatment are growged together with a light separation from each other. Here, the associated fauna are the same as in Fig.3. Fauna is present in these two sides but with very lower densities of spiders, ticks, Pentatomidae, *Monomorium* sp., and *P.fasculatus* at the windward side. The windward and leeward sides of T0 treatment and windward side of T1 treatment are grouped together and characterized by fauna like those of T0 and T1 group in Fig.(2). The windward leeward sides of T3 treatment with leeward side of T1 treatment are grouped together and characterized by fauna like those associated with T3 treatment (Fig.2): Again *Coccinella-11-p* is separated.

Fig. (4) shows graphic representation of applying ordination techniques for population densities of species versus environmental factors for all treatments and all seasons. Each of the environmental factors was classified into two levels as in Fig. (1) by disjunctive coding method, low and high; then population density of each species is distributed according to these two levels. Sixty percent of the total variance is associated with the first axis and 16% with the second one. Distribution of classified factors are the same as in Fig. (1). Lower levels of water content at surface and at -50 cm depth and higher levels of water content at -20 cm depth, organic matter and litter weight are at the left hand side of the figure. With these conditions are associated Tenebrionidae larvae, Pseudoscorpions, *Saprinus* sp., Spiders, *Psammoica lucida*, tick and *Erodium gibbus*. On the other side of the figure,

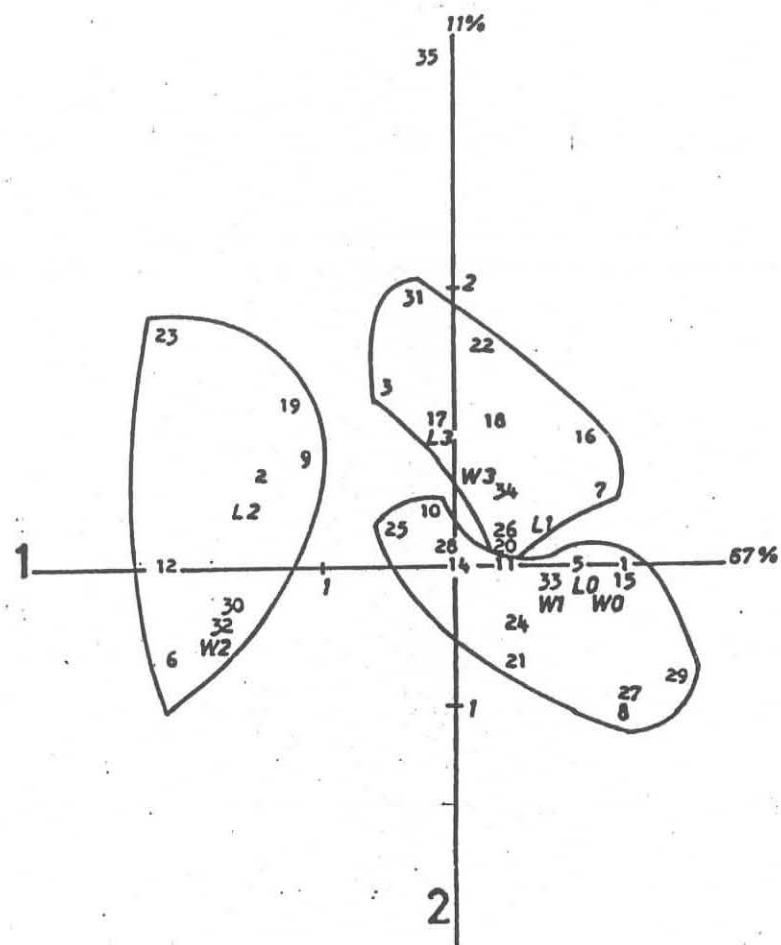


Fig. (3) Graphic representation of applying ordination techniques to data of population density of soil fauna. Symbols: W=windward, L=leeward, large numbers (1-4) represent different treatment sop G.P., species number as in Fig.(2).

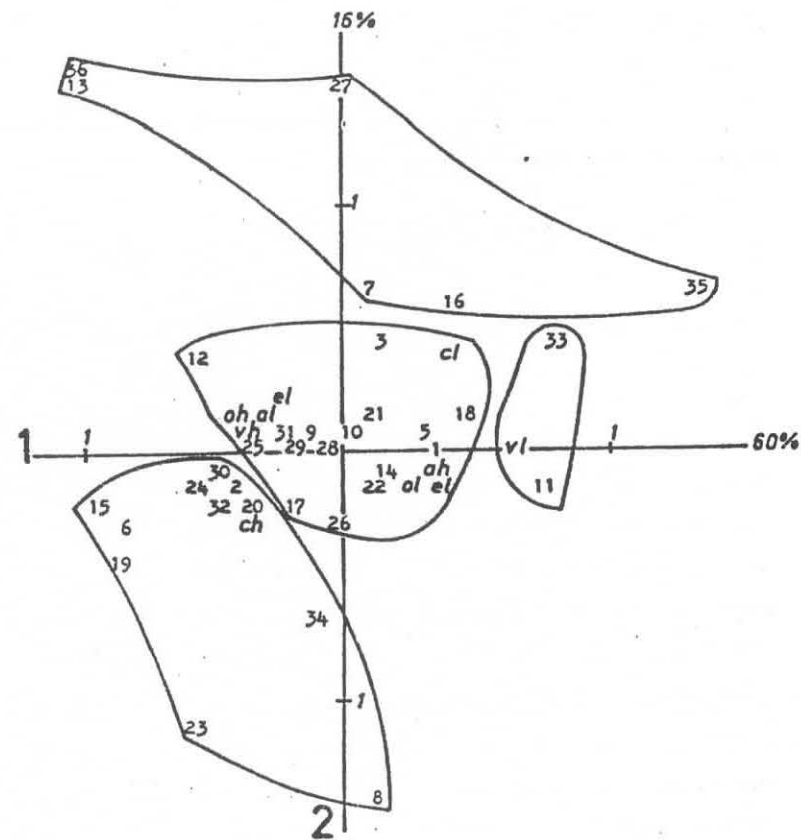


Fig (4) Graphic representation of applying ordination techniques to environmental and population data. Symbols are as in previous figures.

lower levels of water content at -20 cm depth, organic matter and litter weight and higher levels of water content at surface and -50 cm depth are grouped together and characterized by *Heterogamia syriaca*, *Apion* sp., *Isopoda* and *camponotus* sp. Antlions, Diptera larvae, *Erodus*, *quadrilineata*. Scarabaeidae larvae, *Cymindis suturalis*, *Machlopsis crenatocostata* and *Psammobius porcicollis* grouped with either of the above mentioned conditions. Other species are either not affected or negatively related with these conditions.

DISCUSSION

In natural ecosystems, an interrelationship is evolved between range plants and wild animals in which defoliation is as much a part of the ecosystem functioning as is the need for herbage by these animals (Heady, 1975, cited by Ayyad and El-Kadi, 1982). On the other hand protection resulted in an increase in density, vigour and coverage of the vegetation (Ayyad and El-Kady, 1982). This will lead to the accumulation of litter in T2 treatment. Trampling by domestic animals will lead to the removal of litter from under the canopy of *Thymelaea* shrubs, leading to the decrease of the amount of litter as in T1 treatments. T0 and T3 treatments are intermediate but T0 is higher in litter mass than T3. The rate of water percolation is controlled by the amount of litter. Thus, water content at surface is inversely related with litter weight. Plant competition for water also affects the water content at -50 cm depth. T2 and T1 treatments are lower in their water content at -50 cm depth while T0 and T3 are higher.

Fig.(1) shows that while water content at surface and at -50 cm are widely different in the different treatments there is very little difference in the case of water content at -20 cm. The effect of these disparities on soil fauna populations will be obvious. If the wide variation at surface and at -50 cm depth will cause considerable differentiation of the fauna between various treatments, the absence of a sensible difference in water content at -20 cm depth, which is the main zone of activity as well as rest of soil fauna, will tend to obliterate

such differentiation. Because soil fauna are mobile and can choose sites of activity and of rest, such measurements of environmental conditions at various depths will not give a direct and straightforward idea about habitat preferences of these soil animals, as they will be affected by all of these factors but at different times and at different rates. This is more apparent in the case of *Thymelaea* which has a V-shaped life form and therefore does not keep much litter under its canopy, thereby allowing physical environmental factors to act more strongly on the fauna.

Rate of decomposition depends primarily on moisture content of litter and soil (Mikhail, 1982) and will be modified by other factors such as lignin content of litter (Ghabbour *et al.*, 1996). T2 and T1 treatments are higher in organic matter than T0 and T3, since most of litter of T2 and T1 is made up of leaves of light weight which are rather easily decomposable and contribute to higher soil organic matter (Ghabbour *et al.*, 1996).

As a general trend, the number of characteristic taxa of, such treatments decreases with application of protection from grazing. T3 treatment was at first a free grazing area, and when the grazing pressure was reduced to 50%, the number of taxa decreased. Here the word decrease does not necessarily mean elimination of such taxa, but that these taxa are present with much lower densities. Also, the functional groupings of soil animals were affected by G.P. treatments. The number of herbivores increased with protection as a result of the increase of plant biomass, while the detritivores and carnivores are higher with the free grazing treatment. The taxa associated with T0 treatment attained an equilibrium between negative factors of trampling by domestic animals and the positive factors of urine and dung production at maximum stocking rate (Ghabbour and Hussein, 1978). As a result, Scarabaeidae pupae and larvae were present in a lower number in T2 treatment, while they have higher numbers in the other treatments, since these are dung feeding animals. Another example is *H. syriaca* (Diptera, Polyphagidae), a major component of soil Fauna of the

coastal western desert of Egypt (Ghabbour et al, 1977, Mikhail 1982 and Cancela da Fonseca *et al* 1984), found in higher densities in free grazing treatment T0, since the continuous trampling of animals prevents soil crust formation. This taxon is positively affected to a great extent by medium litter weight, water content % at surface and -20 cm depth and organic matter % and the higher value of water content % at -50 cm depth, which are the characteristics of T0 and T1 treatments. The group of taxa associated with T2 treatment is affected by higher amounts of litter accumulated under *T. hirsuta* shrub.

The controlling of grazing pressure in such rangelands as a management practice in the area of Mediterranean desert ecosystem of Northern Egypt provoke certain physical and biological changes in the soil. The two extremes T0, the 100% G.P., and T2, treatments seem to be more suitable, regarding the dynamics of soil fauna populations and their functional groupings.

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No	SYM	Name
1	ISO	Isopoda
2	THY	Thysanura
3	MAN	Mantidae
4	ACR	Acrididae
5	HET	<i>Heterogamia syriace</i>
6	PEN	Pentatomidae
7	CAP	<i>Capsoles sp.</i>
8	HEM	Hemiptera
9	ANT	Antlions
10	DIP	Diptera larvae
11	CAM	<i>Camponotus sp.</i>
12	MES	<i>Messor sp.</i>
13	MON	<i>Monomoprium sp.</i>
14	CYM	<i>cymindis suturalis</i>
15	SCA	<i>Scarites buparius</i>
16	GRA	<i>Graphopterus serrator</i>
17	BRA	<i>Brachycerus spicollis</i>
18	API	<i>Apion sp.</i>
19	DEN	<i>Dendarus piceus</i>
20	ERG	<i>Erodus gibbus</i>
21	ERQ	<i>Erodus quadrileneata</i>
22	MAC	<i>Machlopsis crenatocostis</i>
23	PIM	<i>Pimelia Sp.</i>
24	PSA	<i>Psammoica lucida</i>
25	TEN	Tenbrionidae larvae
26	PSP	<i>Psammobius porcicollis</i>
27	SCP	<i>Scarabaeidae pupa</i>
28	SCL	<i>Scarabaeidae larvae</i>
29	SAP	<i>Saprinus sp.</i>
30	SPL	Spiders
31	PSE	Pseudoscorpions
32	TIC	Ticks
33	GEO	<i>Geophilus sp.</i>
34	SCO	Scorpions
35	COC	<i>Coccinella 11 p</i>
36	PHA	<i>Pharaonus fuscus</i>

بعض مظاهر الأنواع الهامة من حيوانات التربة فى صحراء ساحلية أفرومتوسطية

٥ - عشائر حيوانات التربة المرتبطة بنبات المتنان

تأليف

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ملخص

أجريت هذه الدراسة فى محمية العميد للمحيط الحيوى ومساحتها ١٠×١٠ كم وتقع على مسافة ٨٢ كم غرب الإسكندرية ، ١٠ كم جنوب الشاطئ، وتتبع نظام المناخ المتوسطى الجاف الصحراوى . حيث لا يزيد متوسط المطر عن ٩٠ مم سنويا وترتبط جيرية مختلطة بنسب متفاوتة من السيليكات. والنباتات السائدة هى شجيرات المتنان والعجرم مع بعض الأنواع الأخرى، وحيوانات الرعى هى الخراف والماعز. وقد أجريت تجربة لحماية الغطاء النباتى من الرعى الجائر منذ عام ١٩٧٤ بتحديد ٤ قطع منع فيها الراعى بنسب صفرو ٢٥ و ٥٠ و ١٠٠٪ من المعدل الخارجى. وقد أخذت عينات من حيوانات التربة المرتبطة بالشجيرات السائدة على مدى خمسة فصول متتالية من أسفل هذه الشجيرات لمدة أكثر من عام من القطع المحمية وكذلك من خارجها. وتتناول الورقة هنا تحليل البيانات التى توفرت من الدراسة عن عشائر حيوانات التربة التى جمعت من أسفل شجيرات المتنان فى القطع المختلفة والمعرضة لضغوط رعى متفاوتة فى الشدة، باستخدام الأساليب الإحصائية المتقدمة من التحليل التوافقى للعوامل والتصنيف الهرارى التصاعدى. وأجريت محاولة للربط بين الأنواع الهامة من حيوانات التربة التى جمعت، وبين مختلف العوامل البيئية السائدة فى المنطقة تحت الظروف الموجودة على مدار العام . وقد تبين أن حيوانات التربة العاشية (أى

الآفات المحتملة) ازدادت مع الحماية من الرعى، بينما كانت أعلى العشائر كثافة بالنسبة للمحلات (أو المفككات) ، وهى المسئولة عن خصوبة التربة، فى المناطق الواقعة تحت الرعى الحر (أى فى الحقيقة الرعى الجائر) . وكانت قطع الرعى ذات النظام المعتدل (٢٥ و ٥٠ ٪) متوسطة فى الكثافة العشائرية لهاتين المجموعتين الوظيفيتين من حيوانات التربة، وكذلك فى كل من الخصائص الفيزيائية والكيميائية .